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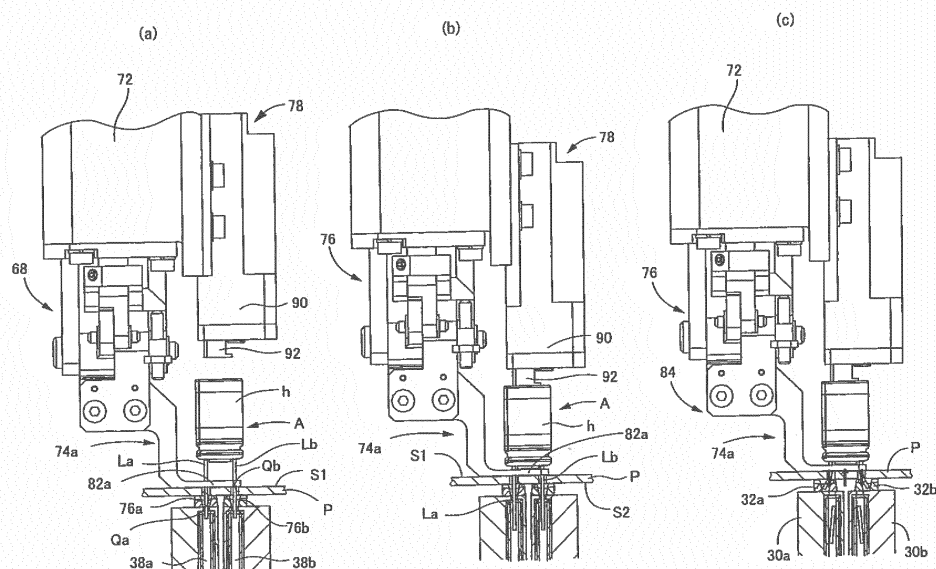
(54) **LEAD COMPONENT MOUNTING APPARATUS AND LEAD COMPONENT MOUNTING METHOD**

(57) In a case in which cutting and clinching is performed on a lead component, a load which is applied to attachment sections of lead wires of the lead component is reduced.

Lead wires La and b are pinched and held from both sides by a pair of pawl portions 74a and b, and the lead wires La and b are inserted into through-holes Qa and b of a board P. The holding by the pawl portions 74a and b is loosened, and a component main body h is pushed in by a pushing-in device 78 until the component main body h comes into contact with the pawl portions 74a and

b. Subsequently, the strength of the holding by the pawl portions 74a and b is increased, and the cutting and clinching of the lead wires La and b is performed. Since sliding movement of the lead wires La and b is in a state of being suppressed by the pawl portions 74a and b, a tensile force which is applied to the lead wires La and b is rendered difficult to transmit to the component main body h side, and it is possible to reduce the load which is applied to the attachment sections of the lead wires of the lead component.

[FIG. 7]



Description

Technical Field

[0001] The present invention relates to a lead component mounting machine which mounts lead components onto a circuit board to assemble an electronic circuit.

Background Art

[0002] PTL 1 and PTL 2 describe a lead component mounting machine provided with a component insertion device which inserts a lead wire of a lead component into a through-hole of a circuit board from one side, and a cut-and-clinch device which cuts and bends a protruding portion of the lead wire which protrudes from the other side of the circuit board.

[0003] In the lead component mounting machine described in PTL 1, a lead wire of an axial lead component is held by a chuck on portions facing both sides of a component main body, and is inserted into a through-hole. In a state in which the lead wire and the component main body are held by the chuck, the protruding portion of the lead wire is cut and bent from the other side. In the lead component mounting machine described in PTL 2, the lead wire of the lead component is held in a state of being pinched by a pair of pawl portions, and is inserted into a through-hole. Subsequently, the holding by the pair of pawl portions is released, and the component main body is pushed downward by a pushing-in device. In a state in which the component main body is pushed in by the pushing-in device, the protruding portion of the lead wire is cut and bent.

Citation List

Patent Literature

[0004]

PTL 1: JP-A-5-175696
PTL 2: JP-A-2002-261493

Summary of Invention

Technical Problem

[0005] The task of the present invention is to suppress the load which is borne by the lead component in a case in which the lead wire of the lead component is cut and clinched.

Solution to Problem

[0006] In a lead component mounting machine according to the present invention, a lead wire is cut and clinched in a state of being pinched from both sides by pawl portions.

[0007] A tensile force is applied to the lead wire, caused by the cut-and-clinch operation; however, since the lead wire is in a state of being pinched from both sides by the pawl portions, the tensile force is rendered difficult to transmit to the component main body side of the lead component. As a result, it is possible to reduce the tensile force which is applied to an attachment section of the lead wire of the component main body, and it is possible to suppress the load borne by the lead component.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a perspective view illustrating a lead component mounting machine which is an embodiment of the present invention. In the present lead component mounting machine, the lead component mounting method which is an embodiment of the present invention is carried out.

[Fig. 2] Fig. 2 is a perspective view of a cut-and-clinch device and a board conveyance device which are included in the lead component mounting machine.

[Fig. 3] Fig. 3(a) is a perspective view of a cut-and-clinch unit which is included in the cut-and-clinch device. Fig. 3(b) is a sectional diagram of a portion of the cut-and-clinch unit.

[Fig. 4] Fig. 4 is a perspective view illustrating a component insertion device which is included in the lead component mounting machine.

[Fig. 5] Fig. 5(a) is a side surface view of a chuck which is attached to a work head of the component insertion device. Fig. 5(b) is a rear surface view of the chuck. Fig. 5(c) is a front surface view of the chuck.

[Fig. 6] Fig. 6 is a block diagram conceptually illustrating a control device of the lead component mounting machine.

[Fig. 7] Figs. 7(a) to 7(c) are diagrams of operations of the chuck and the cut-and-clinch device.

[Fig. 8] Figs. 8 are diagrams illustrating forces acting on a lead component A in a case in which cutting and clinching is performed by the cut-and-clinch device.

[Fig. 9] Fig. 9 (a) is a side surface view of a different chuck which is attached to the work head. Fig. 9 (b) is a front surface view of the chuck.

Description of Embodiments

[0009] Hereinafter, description will be given of an embodiment of the present invention with reference to the drawings. In addition to the embodiment described below, it is possible to embody the present invention with various modifications and improvements based on the knowledge of a person skilled in the art.

[0010] As illustrated in Fig. 1, the lead component mounting machine which is a type of automated assembly

bly apparatus includes (a) an assembly apparatus main body 10, (b) a board conveyance device 12, (c) a component supplying device 14, (d) a component insertion device 16, (e) a cut-and-clinch device 18, and the like.

[0011] The board conveyance device 12 conveys and holds a circuit board P (hereinafter, briefly referred to as board P) in a horizontal posture. In Fig. 1, x is a conveyance direction of the board P by the board conveyance device 12, y is a width direction of the board P, and z is a thickness direction of the board P, that is, the vertical direction of the lead component mounting machine. The x-direction, the y-direction, and the z-direction orthogonally intersect each other.

[0012] The component supplying device 14 supplies components to be mounted onto the board P, for example, the component supplying device 14 may include a plurality of tape feeders, may include a plurality of trays, and the like. In the present embodiment, a lead component in which a plurality of lead wires and a component main body are integrally formed is supplied.

[0013] The component insertion device 16 is provided above the board conveyance device 12, receives the lead component which is supplied in the component supplying device 14, and inserts the lead wires of the lead component into a through-hole which is provided in a predetermined position among a plurality of through-holes which are formed in the board P which is held by the board conveyance device 12. Description will be given of the component insertion device 16 later.

[0014] The cut-and-clinch device 18 is a device which is provided under the board conveyance device 12, cuts a portion, which protrudes from the bottom (the other side) of the board P, of the lead wire of the lead component which is inserted from above (one side) into a predetermined through-hole of the plurality of through-holes which are formed in the board P to a predetermined length, bends the lead wire along the reverse surface of the board P, and thus, temporarily fixes the lead component to the board P. As illustrated in Figs. 2 and 3, the cut-and-clinch device 18 includes a cut-and-clinch unit 20, and a unit moving device 22 which causes the cut-and-clinch device 20 to move (including linear movement and rotation).

[0015] As illustrated in Fig. 3 (a), the cut-and-clinch unit 20 includes (a) a unit main body 28, (b) a pair of first movable sections 30a and b which are held by the unit main body 28 to be capable of moving linearly in the horizontal direction, (c) a pair of second movable sections 32a and b which are held by the first movable sections 30a and b, respectively, to be capable of relative movement in the horizontal direction, (d) a pitch changing device 34 which is provided on the unit main body 28 and changes the interval (the pitch) between the pair of first movable sections 30a and b by causing the pair of first movable sections 30a and b to approach and separate in relation to each other, (e) movable blade driving devices 36a and b which cause the second movable sections 32a and b to move relative to the first movable sec-

tions 30a and b, respectively, and the like.

[0016] As illustrated in Fig. 3(b), the pair of first movable sections 30a and b include lead wire insertion holes 38a and b which extend in the vertical direction. The lead wire insertion holes 38a and b include openings in the top end surfaces of the first movable sections 30a and b, and the opening edges thereof are stationary blades 40a and b. In comparison, the top end portions of the second movable sections 32a and b are substantially L-shaped and include a portion which extends upward and a portion which is bent approximately at a right angle thereto. Blade-forming sections 44a and b which are the portions which are bent at a right angle are positioned above the top end surfaces of the first movable sections 30a and b, and lead wire guide holes 46a and b which penetrate in the vertical direction are formed in portions facing the openings of the lead wire insertion holes 38a and b. The bottom end opening edges of the lead wire guide holes 46a and b of the blade-forming sections 44a and b are movable blades 48a and b. The lead wires which extend into the lead wire insertion holes 38a and b are cut and bent due to the pair of second movable sections 32a and b being caused to approach and separate in relation to each other by the movable blade driving devices 36a and b.

[0017] As illustrated in Fig. 2, the unit moving device 22 includes an x-direction moving device 52 which causes the cut-and-clinch unit 20 to move in the x-direction, a y-direction moving device 53 which causes the cut-and-clinch unit 20 to move in the y-direction, a z-direction moving device 54 which causes the cut-and-clinch unit 20 to move in the z-direction, a θ -rotation device 55 which causes the cut-and-clinch unit 20 to rotate around a vertical line, and the like.

[0018] As illustrated in Fig. 4, the component insertion device 16 includes two work heads 60 and 61, and a work head moving device 62. The work head moving device 62 includes an x-direction moving device 64, a y-direction moving device 65, and z-direction moving devices 66 and 67. The work heads 60 and 61 are caused to move integrally to an arbitrary position in a horizontal plane by the x-direction moving device 64 and the y-direction moving device 65, and may be caused to move in the z-direction individually and independently by the z-direction moving devices 66 and 67, respectively. The work head 60, which is one of the two work heads, is provided with a component holding tool 68 (for example, it is possible to use a chuck, a suction nozzle, or the like) which holds the lead component. A camera 70 is provided to be capable of moving integrally with the work head 60.

[0019] In the present embodiment, the chuck 68 illustrated in Figs. 5(a) to (c) is attached as the lead component holding tool (which may also be referred to as a lead component mounting tool). The lead component A is a radial lead component, and two lead wires La and b are attached to a component main body h in parallel. The chuck 68 pinches and holds the two lead wires La and b of the lead component A from both sides in the direction

in which the two lead wires La and b are lined up. The chuck 68 includes (a) a chuck main body 72, (b) a pair of pawl portions 74a and b which are attached to the chuck main body 72 to be swingable, (c) a swing device 76 which causes the pair of pawl portions 74a and b to swing, (d) a pushing-in device 78 which pushes in the lead component A, and the like.

[0020] The pawl portions 74a and b are substantially L-shaped, and include base end sections 80a and b which extend in the z-direction, and holding sections 82a and b which extend out from the base end sections 80a and b in a substantially horizontal direction. As illustrated in Fig. 5(a), in plan view, a recessed section 83b which is recessed in a protruding shape on one of the mutually-facing sides of the holding sections 82a and b (in the present embodiment, the side of the holding section 82b which faces the holding section 82a), and the lead wires La and b are held in a state of being accommodated by the recessed section 83b in a state of being pinched by the pair of holding sections 82a and b. Specifically, since two surfaces 83p and q which form the recessed section 83b and another (the side of the holding section 82a which faces the holding section 82b) surface 83a are the contact surfaces of the lead wires La and b, the lead wires La and b are held by the friction force between the lead wires La and b and the three contact surfaces 83p, q, and 83a.

[0021] The swing device 76 includes an air cylinder as a driving source which is not illustrate, and a swing mechanism 84. The swing mechanism 84 includes (a) a driving member 85 which extends in the horizontal direction and is provided in a fixed manner on a rod which serves as an output member of the air cylinder, (b) two first members 86p and q which are joined to both end portions of the driving member 85 to be relatively swingable, (c) second members 88p and q which are substantially L-shaped, one end portion of each is joined to the two first members 86p and q to be swingable, the pawl portions 74a and b are fixed integrally to the other end portion to be swingable, and the middle portion is joined, to be swingable, to a swing shaft 87 which is provided on the chuck main body 72, and the like.

[0022] If the driving member 85 is caused to move in the z-direction by the air cylinder, the second members 88p and q are caused to swing around the swing shaft 87, and the pair of pawl portions 74a and b are caused to approach or separate in relation to each other. The pair of pawl portions 74a and b are caused to approach each other by causing the driving member 85 to move upward, and the pair of pawl portions 74a and b are caused to separate from each other by causing the driving member 85 to move downward. The approaching and separating of the pair of claws 76a and b is controlled by controlling the air supply state of the air cylinder.

[0023] The pushing-in device 78 includes (a) a pushing-in device main body 90 which is provided on the chuck main body 72 to be capable of moving in the z-direction (capable of being lifted and lowered), (b) a pressing mem-

ber 92 which is attached to the bottom end portion of the pushing-in device main body 90, and (c) a lifting and lowering device 94 which lifts and lowers the pushing-in device main body 90 in relation to the chuck main body 72.

The lifting and lowering device 94, for example, may include an air cylinder which serves as a driving source which is not illustrated, and a pair of guide mechanisms 96r and s which are provided between the chuck main body 72 and the pushing-in device main body 90. The guide mechanisms 96r and s include the chuck main body 72, long holes 97r and s which are provided on both end portions in the horizontal direction of the pushing-in device main body 90 and extend in the z-direction, and two each of engaging protruding sections 98r and s which are attached to the chuck main body 72, and the long holes 97r and s and the engaging protruding sections 98r and s are engaged with each other to be capable of relative movement. It is possible to cause the main body 90 to be lifted and lowered along the guide mechanisms 96r and s, and to cause the pressing member 92 to be lifted and lowered by controlling the air supply state in the air cylinder which is the driving source.

[0024] The swing device 76 and the lifting and lowering device 94 are not limited to using air cylinders as driving sources, and may include electric motors or the like.

[0025] As illustrated in Fig. 6, the lead component mounting machine is controlled by a main control device 100, the main constituent of which is a computer. A component supply control section 102, a board conveyance control section 104, a component insertion control section 106, a cut-and-clinch control section 108, and the like, the main constituent of which is a computer, are connected to the main control device 100 to be capable of mutual communication. The control sections 102 to 108 control the component supplying device 14, the board conveyance device 12, the component insertion device 16, and the cut-and-clinch device 18 described earlier, respectively.

[0026] In the lead component mounting machine, it is not essential to provide a control section for each device such as the component supplying device 14, all of the devices may be controlled based on commands of the main control device 100, or the like, and the configuration of the control device is not limited to that described in the present embodiment.

[0027] In the lead component mounting machine, from above the board P which is conveyed by the board conveyance device 12, the two lead wires La and b of the lead component A are inserted by the component insertion device 16 into two through-holes Qa and b which are formed in predetermined positions on the board P. Meanwhile, the two lead wires La and b are cut and bent at a predetermined length in the below of the board P by the cut-and-clinch device 18.

<Cut-and-Clinch Operation Described in PTL 2>

[0028] In the lead component mounting machine de-

scribed in PTL 2, as illustrated in Figs. 8(a) and (b), the component main body h of the lead component A is pushed in by the pushing-in device 78 until coming into contact with an upper surface S1 of the board P, and in this state, the cutting and clinching is performed. In the cut-and-clinch device 18, the second movable sections 32a and b are caused to move in the horizontal direction. The lead wires La and b are cut by the stationary blades 40a and b and the movable blades 48a and b, and the lead wires La and b are bent by an opening peripheral portion of the lead wire guide holes 46a and b of the second movable sections 32a and b and a bottom surface S2 of the board P. However, the top end surfaces of the second movable sections 32a and b are in positions in close proximity to the bottom surface S2 of the board P. The lead wires La and b have a thickness (a diameter), and there is a gap between the lead wires La and b and the through-holes Qa and b. Therefore, in a case in which the lead wires La and b are bent, a downward tensile force acts on the lead wires La and b, while an upward pushing up force Fup acts on the board P, and the upward pushing up force Fup acts on the component main body h. Therefore, a large downward force acts on the attachment section periphery of the lead wires La and b of the component main body h, and a large load is applied to the lead component A. For example, in a case in which the strength of the component main body h is low, the attachment section periphery or the like of the component main body h may be damaged. In a case in which the attachment strength of the lead wires La and b in relation to the component main body h is low, the lead wires La and b may become detached.

<Cut-and-Clinch Operation Described in Present Embodiment>

[0029] In comparison, in the present embodiment, as illustrated in Figs. 7(a) to (c), the cutting and clinching is performed in a state in which the lead wires La and b are pinched from both sides at a portion which is higher than the board P by the chuck 68.

(1) As illustrated in Fig. 7(a), after the lead wires La and b are inserted by the chuck 68 into the two through-holes Qa and b, respectively, which are formed in predetermined positions on the board P, the chuck 68 is lowered until the bottom surfaces of the holding sections 82a and b of the pair of pawl portions 74a and b come into contact with the upper surface S1 of the board P. The lead wires La and b reach the lead wire insertion holes 38a and b via the lead wire guide holes 46a and b of the cut-and-clinch device 18.

(2) The swing angle of the pair of claws 74a and b is rendered slightly larger under the control of the swing device 76. The holding of the lead wires La and b by the pair of pawl portions 74a and b is loosened, and the holding strength is set to less than or

equal to a set strength, that is, to a degree which allows the relative movement (sliding) of the lead wires La and b in relation to the pawl portions 74a and b. As illustrated in Fig. 7(b), the pressing member 92 is caused to move downward under the control of the pushing-in device 78. While the lead wires La and b are caused to slide in relation to the holding sections 82a and b, the lead component A is caused to move downward until the bottom surface of the component main body h comes into contact with the upper surfaces of the holding sections 82a and b of the pawl portions 74a and b.

(3) The swing angles of the pair of pawl portions 74a and b are reduced under the control of the swing device 76, and the lead wires La and b are held strongly. The holding strength of the pair of pawl portions 74a and b is set to a degree at which the relative movement (sliding) of the lead wires La and b in relation to the holding sections 82a and b is suppressed adequately as a result of the cutting and clinching operation.

(4) As illustrated in Fig. 7(c), the lead wires La and b are cut and bent by the cut-and-clinch device 18. In this case, although the pushing up force Fup acts on the board P and a tensile force Fp is applied to the lead wires La and b, since the lead wires La and b are in a state of being pinched and held by the pair of pawl portions 74a and b, the tensile force Fp is rendered difficult to transmit to the component main body side, that is, the tensile force Fp is rendered difficult to transmit to the attachment sections of the lead wires La and b in relation to the component main body h. The pushing up force Fup from the board P acts on the holding sections 82a and b of the pawl portions 74a and b, and the pushing up force Fup is received by the chuck main body 72 via the pawl portions 74a and b and the swing mechanism 84. As a result, the pushing up force Fup is rendered difficult to transmit to the component main body h.

In this manner, since the cutting and clinching is performed in a state in which the lead wires La and b are pinched by the pair of pawl portions 74a and b, it is possible to reduce the force of the lead wires La and b acting on the attachment section periphery of the component main body h, and it is possible to reduce the load applied to the lead component A.

Accordingly, even if the attachment strength of the lead wires La and b to the component main body h is low, it is possible to render the lead wires La and b difficult to detach from the component main body h. Even if the strength of the component main body h is low, it is possible to render the component main body h difficult to damage at the attachment section periphery.

Even in a case in which the component main body h is fragile and it is difficult to push in the component main body h using the pushing-in device 78, since the cutting and clinching is performed in a state in

which the lead wires La and b are held by the pair of pawl portions 74a and b, the lead component A inclining during the cut-and-clinch operation is avoided, and it is possible to perform the cutting and clinching in a state in which the posture of the lead component A is maintained.

(5) After the cutting and clinching is completed, the pressing member 92 is moved upward, the pair of claws 74a and b are opened, and the holding of the lead wires La and b is released. Although there is a case in which the component main body h slips down by the thickness amount of the pawl portions 74a and b, the slipping down amount is small. After the cut-and-clinch operation, there is a case in which a gap is filled by soldering or the like being performed.

[0030] In the present embodiment, a pawl portion movement control section, and a pushing-in device control device are configured by the component insertion control section 106 and the like. The operation of (1) which is described above and illustrated in Fig. 7 (a) corresponds to a component insertion process, and the operation of (4) which is described above and illustrated in Fig. 7(c) corresponds to the cutting and clinching process.

[0031] The lead component holding tool may be the one which has the structure illustrated in Figs. 9(a) and (b).

[0032] In the present embodiment, a chuck 110 is attached as the lead component holding tool. The chuck 110 is a slide-type chuck, and includes (a) a pair of pawl portions 112a and b which are capable of approaching and separating in relation to each other, (b) a spacer 114 which is positioned between the pair of pawl portions 112a and b, (c) an approaching and separating device 116 which causes the pair of pawl portions 112a and b to approach and separate, (d) a pushing-in device 118, and the like. The approaching and separating device 116 includes a driving source such as an air cylinder which is not illustrated, a pair of sliders 120a and b which are caused to approach and separate in relation to each other in the horizontal direction by the driving source, and the like, and the pawl portions 112a and b are attached to the pair of sliders a and b to be capable of moving integrally therewith. As illustrated in Fig. 9(a), the spacer 114 is positioned between the two lead wires La and b of the lead component A, and the width of the spacer 114 is a size corresponding to the interval between the lead wires La and b of the lead component A. For the spacer 114, a spacer with an appropriate shape for the lead component A is attached.

[0033] As illustrated in Fig. 9 (a), in the present embodiment, in plan view, a protrusion-shaped recessed section is provided on the spacer side of each of the pair of pawl portions 112a and b, and the lead wires La and b are held by the pawl portions 112a and b and the spacer 114 in a state of being stored in the recessed section. Each of the two lead wires La and b is held in a state of

being pinched from both sides by the spacer 114 and the pawl portions 112a and b, that is, by the two pawl portions (112a, 114), and (112b, 114).

[0034] The shape of the lead component which is mounted by the present lead component mounting machine is not an issue. For example, the lead component may have three or more lead wires. In this case, two of the three or more lead wires are cut and clinched in a state of being pinched and held by one pair or two pairs of pawl portions.

[0035] In a case in which the lead wires of the lead component are short or the like, the lead wires may be bent without being cut by the cut-and-clinch device. In a case in which the lead wires do not reach the cutting section included in the cut-and-clinch device, the lead wires are bent without being cut.

Reference Signs List

[0036] 16: component insertion device, 18: cut-and-clinch device, 30: first movable section, 32: second movable section, 68: chuck, 74a and b: pawl portion, 76: swing device, 78: pushing-in device, 82a and b: clamping section, 112a and b: pawl portion, 114: spacer

Claims

1. 1. A lead component mounting machine comprising:
 - a component insertion device which holds two lead wires which are included in a lead component, and inserts the two lead wires into two corresponding through-holes which are formed in a circuit board from one side of the circuit board; and
 - a cut-and-clinch device which cuts and bends protruding portions, which are portions protruding from another side of the circuit board, of the two lead wires which are inserted into the two corresponding through-holes, wherein the component insertion device includes at least a pair of pawl portions which pinch and hold each of the two lead wires from both sides, and
 - wherein the cut-and-clinch device cuts and bends the protruding portions of the two lead wires from the other side of the circuit board in a state in which the two lead wires are held by at least the pair of pawl portions.
2. 2. The lead component mounting machine according to Claim 1, wherein the lead component includes a single component main body which is provided integrally with the two lead wires, and wherein the cut-and-clinch device cuts and bends the protruding portions of the two lead wires in a state

in which each of the two lead wires is pinched and held by at least the pair of pawl portions at a portion between a one side surface of the circuit board and the single component main body.

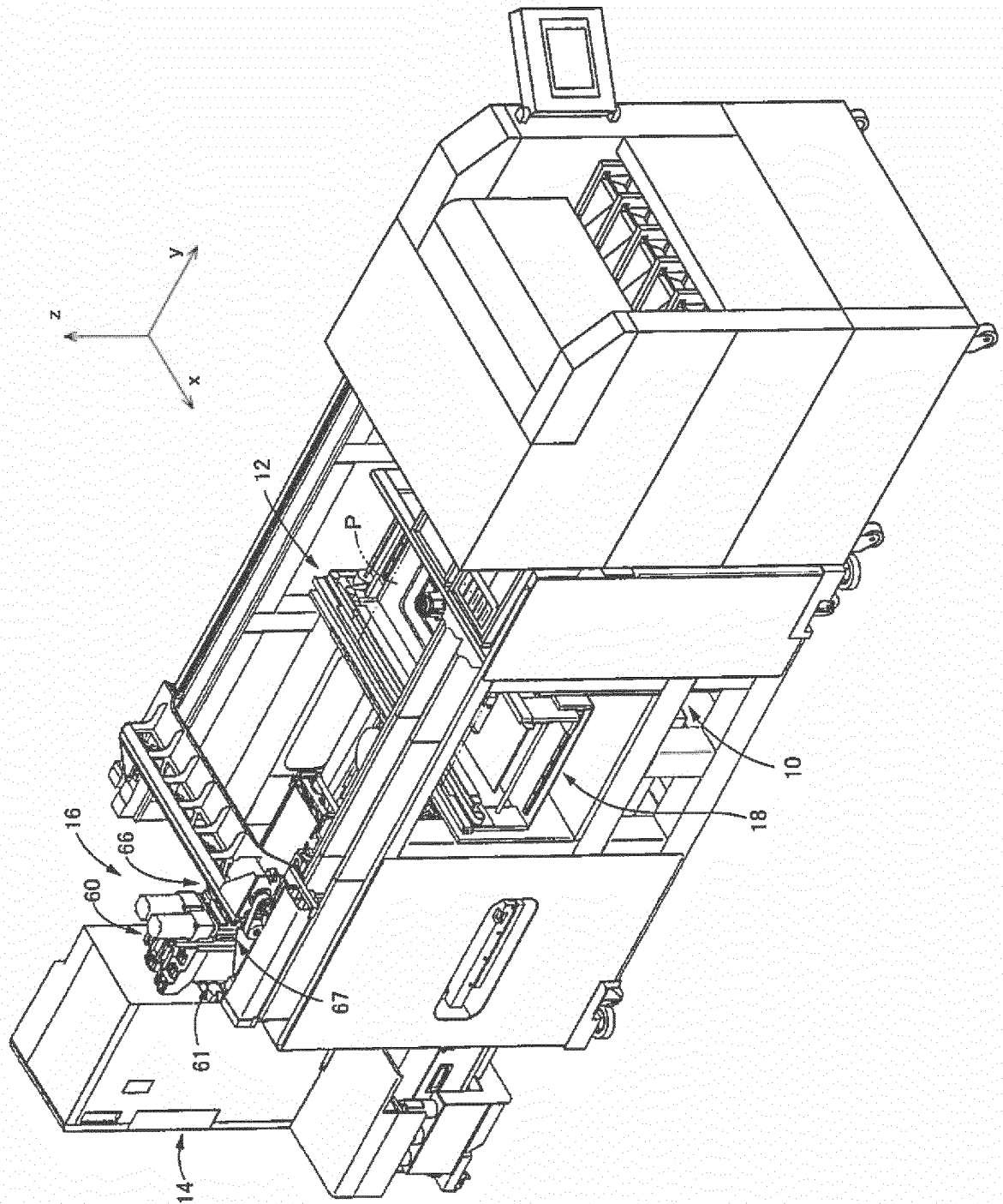
3. 3. The lead component mounting machine according to Claim 1 or 2,
wherein the component insertion device includes a pawl portion movement control section which causes at least the pair of pawl portions to come into contact with the one side surface of the circuit board in a state in which the two lead wires are inserted into the two through-holes. 10
4. 4. The lead component mounting machine according to any one of Claims 1 to 3,
wherein the lead component includes a single component main body which is provided integrally with the two lead wires, and
wherein the component insertion device includes a pushing-in device which pushes in the single component main body toward the circuit board in a state in which the two lead wires are inserted into the two corresponding through-holes. 20
5. 5. The lead component mounting machine according to Claim 4,
wherein the component insertion device includes a pushing-in device control section which causes the pushing-in device to push in the single component main body until the single component main body comes into contact with at least the pair of pawl portions in a state in which the two lead wires are inserted into the corresponding two through-holes, and a holding strength of each of the two lead wires by at least the pair of pawl portions is lower than a set strength. 25 30 35
6. 6. A lead component mounting machine comprising: 40
 - a component insertion device which holds two lead wires which are included in a lead component, and inserts the two lead wires into two corresponding through-holes which are formed in a circuit board from one side of the circuit board; 45
 - and
 - a cut-and-clinch device which cuts and bends protruding portions, which are portions protruding from another side of the circuit board, of the two lead wires which are inserted into the two corresponding through-holes, 50
 - wherein the component insertion device includes at least a pair of pawl portions which hold the two lead wires at portions separated from the single component main body, and 55
 - wherein the cut-and-clinch device cuts and bends the protruding portions of the two lead wires from the other side of the circuit board in

a state in which the two lead wires are held by at least the pair of pawl portions.

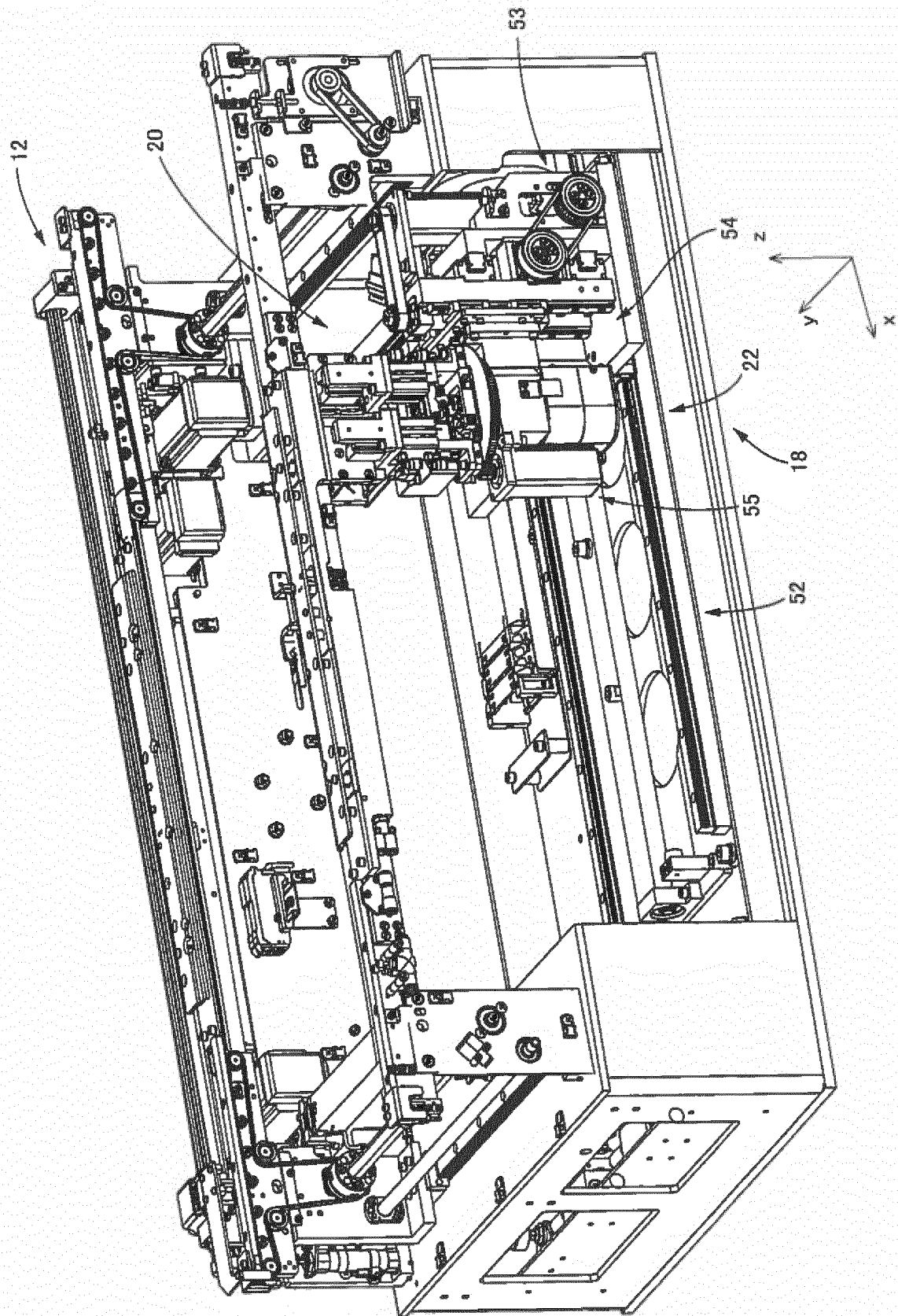
7. 7. A lead component mounting method, comprising:

a component insertion process in which two lead wires are inserted into two corresponding through-holes which are formed in a circuit board from one side of the circuit board in a state in which at least a pair of pawl portions pinches and holds each of the two lead wires which are included in a lead component; and
a cutting and clinching process in which protruding portions, which are portions protruding from another side of the circuit board, of the two lead wires which are inserted into the two corresponding through-holes, are cut and bent in a state in which the two lead wires are held by at least the pair of pawl portions.

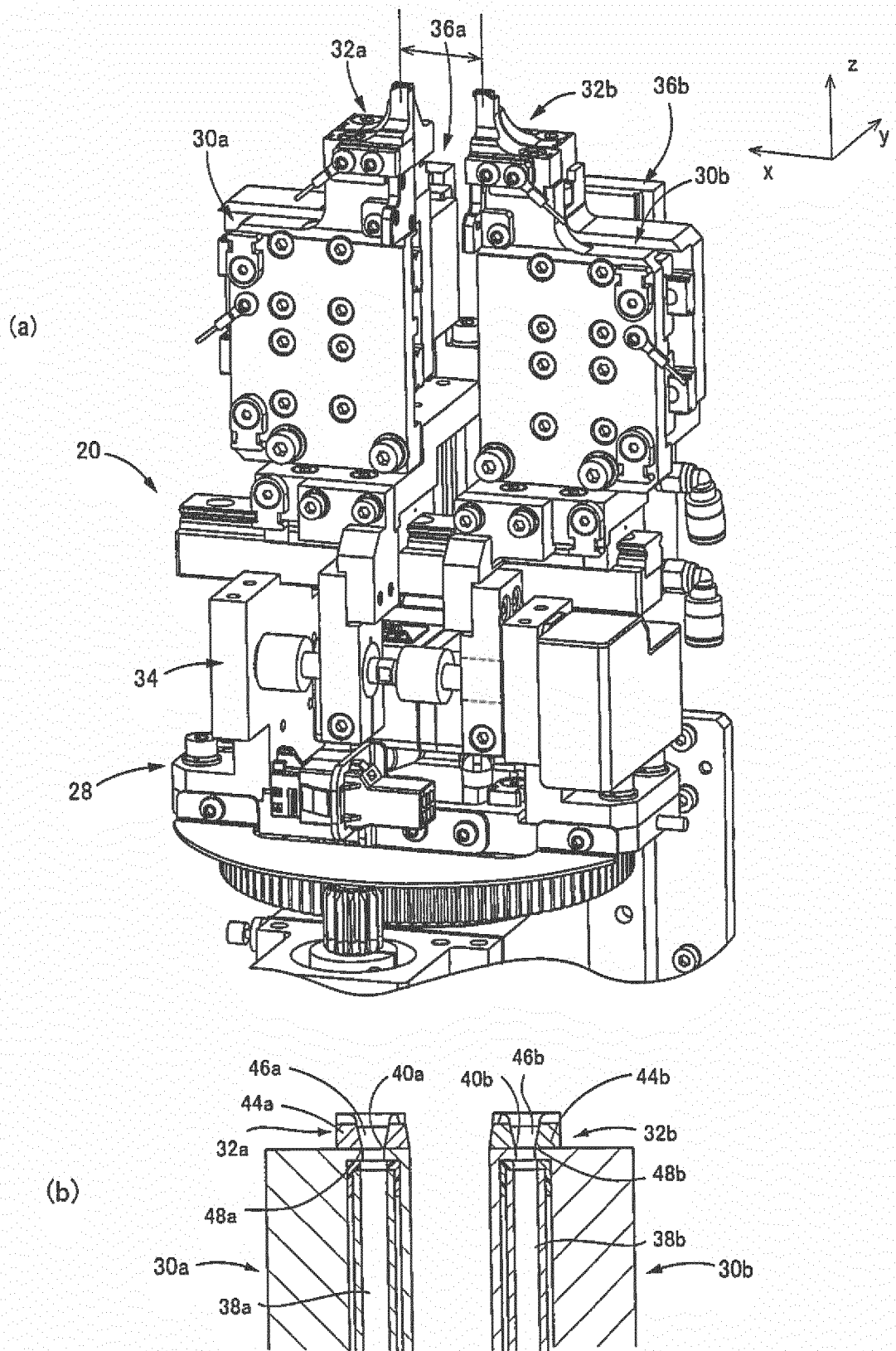
[FIG. 1]



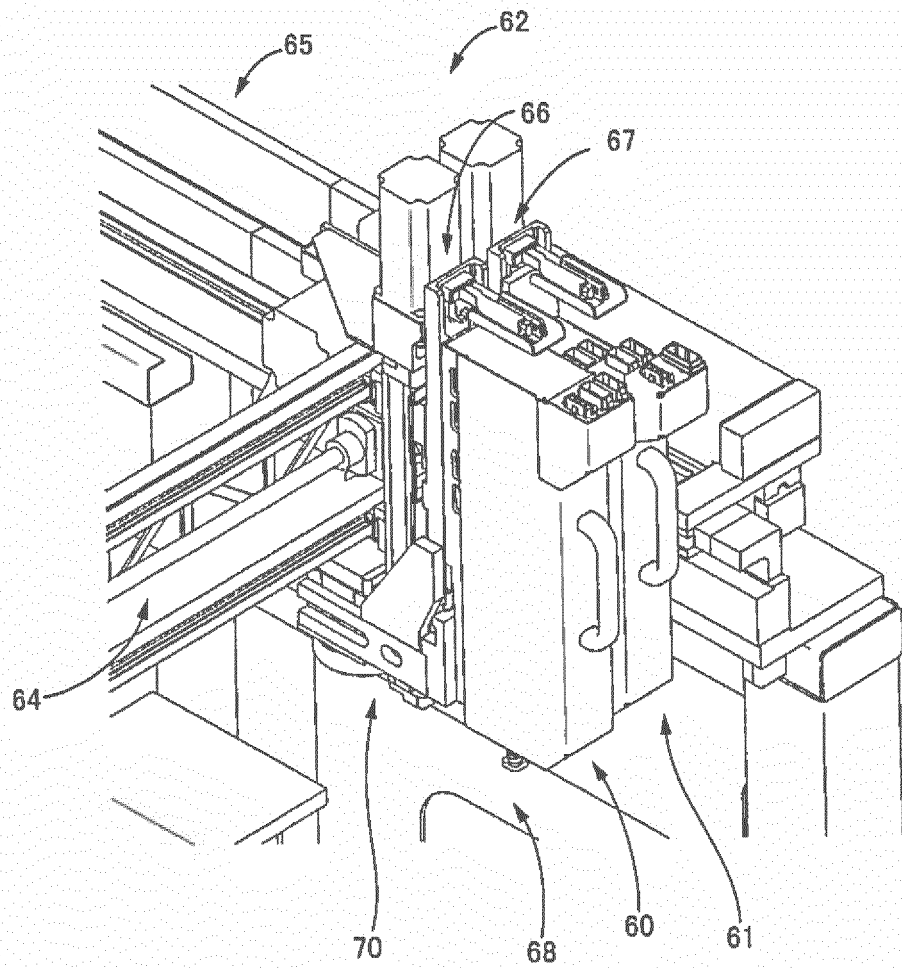
[FIG. 2]



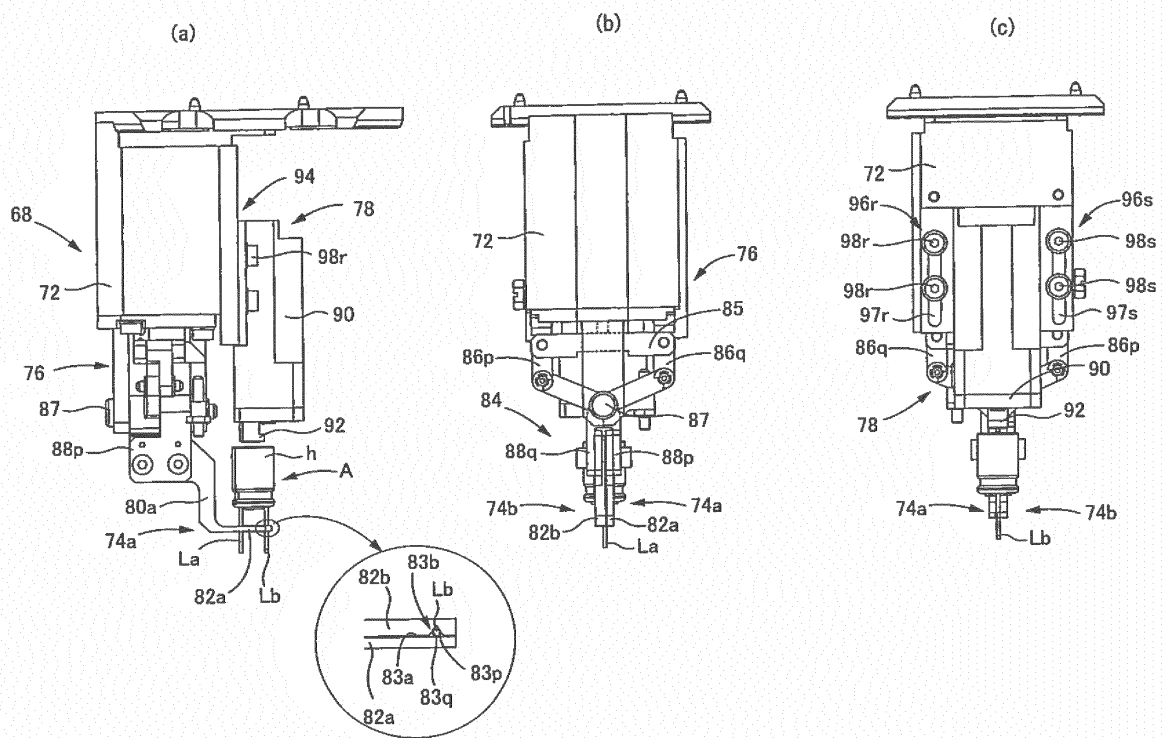
[FIG. 3]



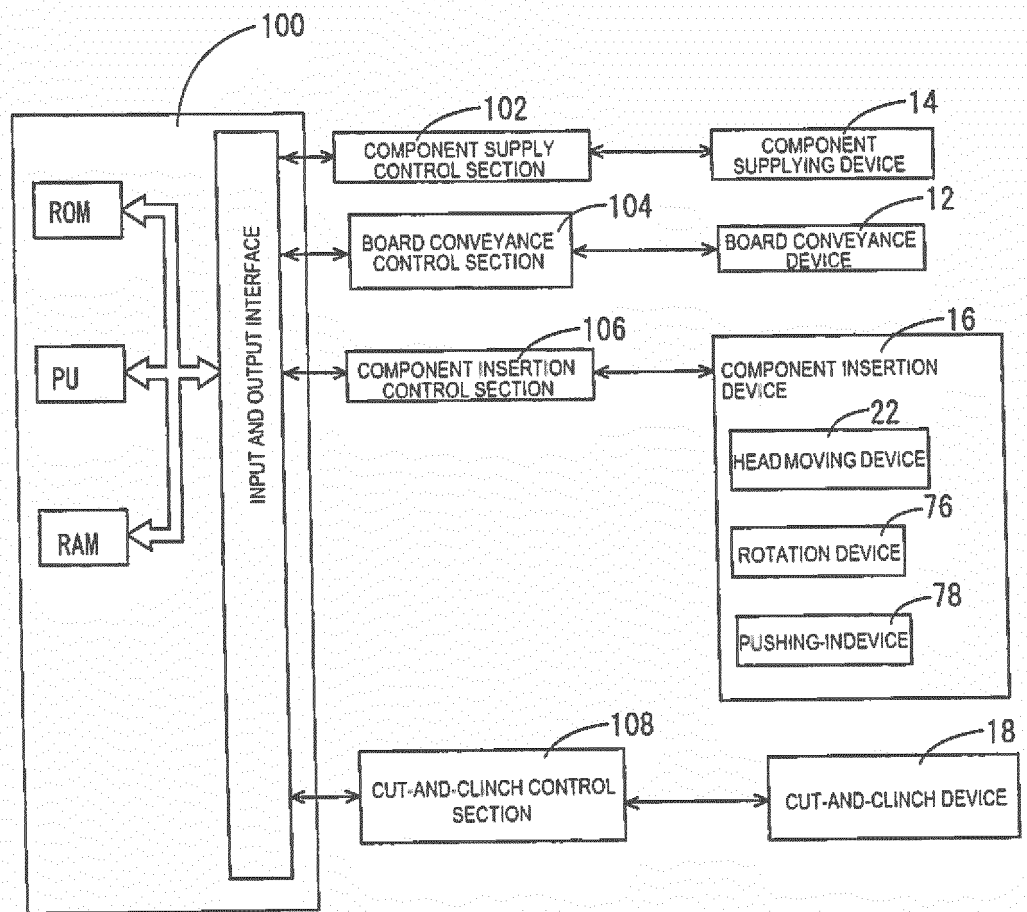
[FIG. 4]



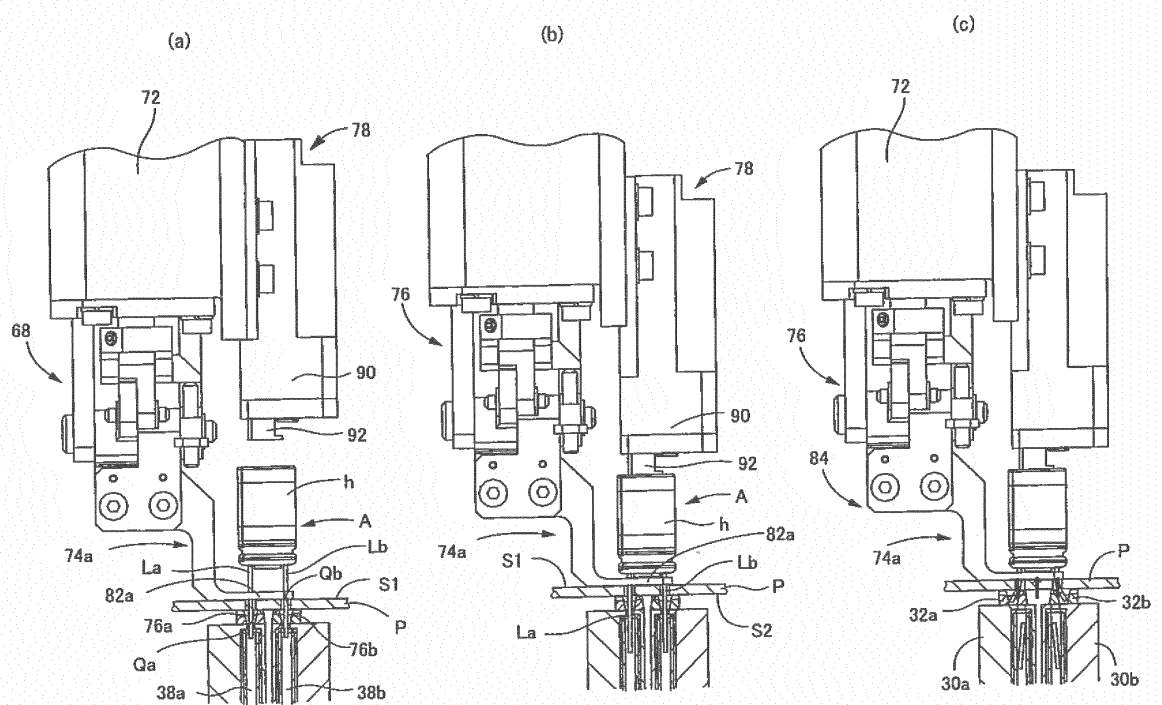
[FIG. 5]



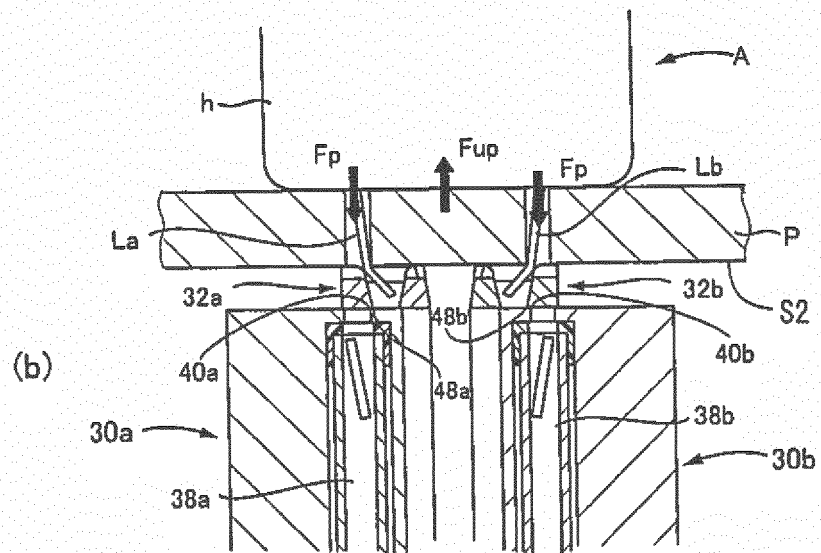
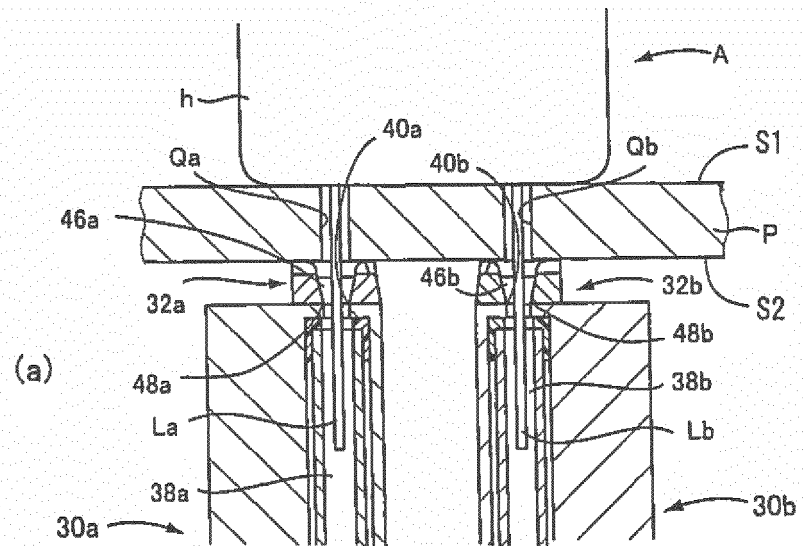
[FIG. 6]



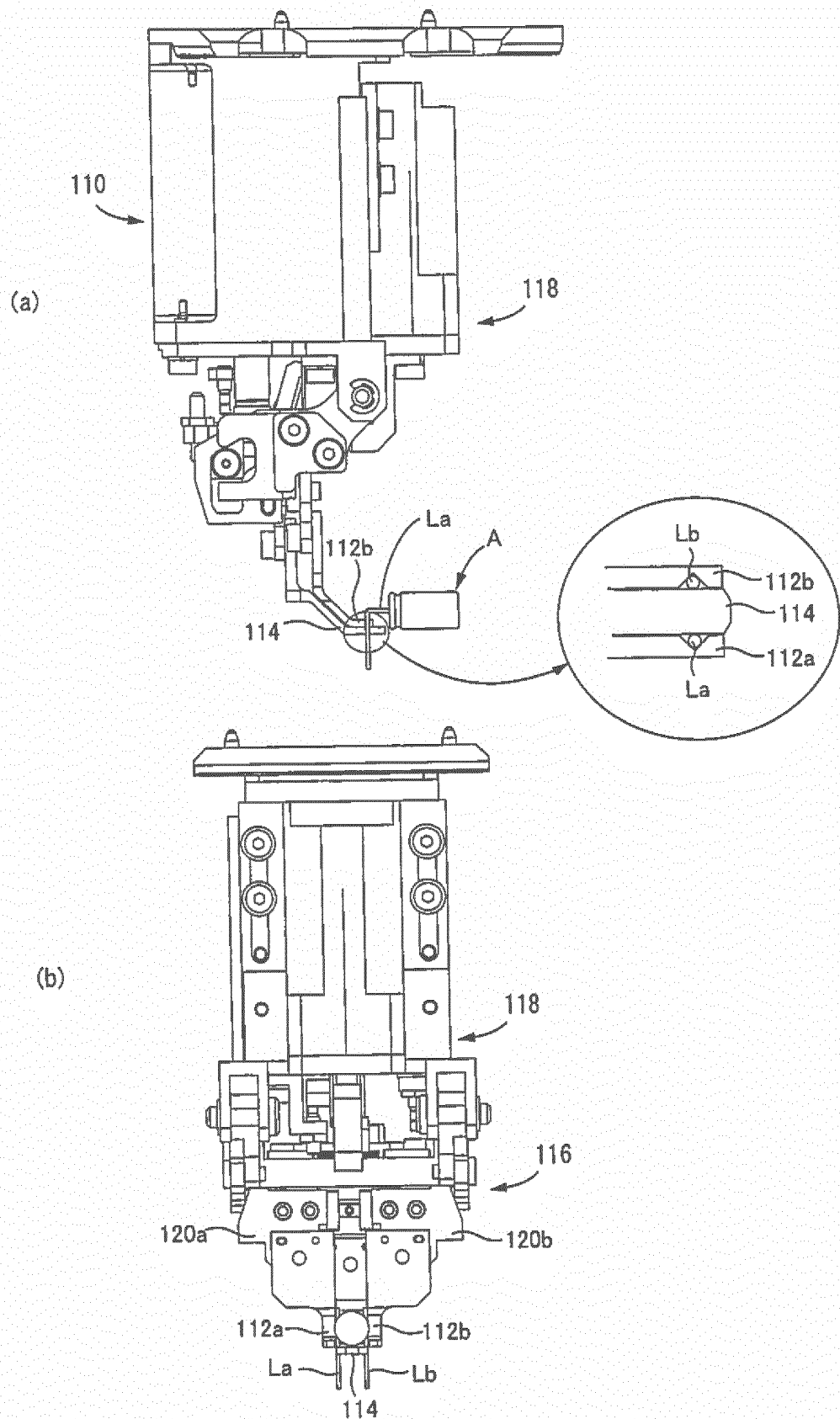
[FIG. 7]



[FIG. 8]



[FIG. 9]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/063285

A. CLASSIFICATION OF SUBJECT MATTER

H05K13/04(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H05K13/00-13/04, B23P19/00, B23P21/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 11-289193 A (Matsushita Electric Industrial Co., Ltd.),	1-3, 6, 7
Y	19 October 1999 (19.10.1999),	4
A	paragraph [0020]; fig. 8 to 10 (Family: none)	5
Y	JP 2-49558 B2 (Nippon Dainapato Kabushiki Kaisha),	4
	30 October 1990 (30.10.1990),	
	page 2, column 4, line 23 to page 3, column 6,	
	line 6; fig. 6A to 6I (Family: none)	

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

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Date of the actual completion of the international search

31 July, 2014 (31.07.14)

Date of mailing of the international search report

12 August, 2014 (12.08.14)

Name and mailing address of the ISA/
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Authorized officer

Facsimile No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/063285

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3246453 B2 (Matsushita Electric Industrial Co., Ltd.), 15 January 2002 (15.01.2002), paragraphs [0113] to [0116]; fig. 45, 49 & US 6671946 B1 & EP 999733 A1 & WO 1999/059390 A1 & DE 69937935 D & DE 69937935 T & TW 427104 B & CN 1269122 A	1-7
A	JP 6-37492 A (Matsushita Electric Industrial Co., Ltd.), 10 February 1994 (10.02.1994), paragraphs [0003], [0004]; fig. 9 (Family: none)	1-7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5175696 A [0004]
- JP 2002261493 A [0004]